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15. Proposed by SETH PRATT, C. E., Assyria, Michigan.

From a point in an equilateral triangle, the distances to the angles are, respectively, 20, 28, and 31 rods. Required a side of the triangle.

Solution by J. F. W. SCHEFFER, A. M., Hagerstown, Maryland.

To establish a general formula, we denote the three given lines by a , b , c , and the required side by x .

Let the perpendicular $OD=z$, $AD=y$, $CE=\frac{x}{2}\sqrt{3}$, $AE=\frac{x}{2}$. Now, we obviously have the three equations: $y^2+z^2=a^2\dots(1)$,

$$(x-y)^2+z^2=b^2\dots(2), \text{ and } \left(\frac{x}{2}\sqrt{3}-z\right)^2$$

$$+\left(\frac{x}{2}-y\right)^2=c^2\dots(3).$$

Substituting the value of $y^2+z^2=a^2$ in (2), we get $x^2-2xy=b^2-a^2$, whence,

$$y=\frac{a^2-b^2+x^2}{2x}\dots(4), \text{ and the value of } x^2+y^2+z^2 \text{ from (2), in (3) and also}$$

$$(4) \text{ in (3), we obtain after a few easy reductions, } z=\frac{a^2+b^2-2c^2+x^2}{2x\sqrt{3}}\dots(5).$$

Substituting (4) and (5) in (1), we have without trouble the quadratic, $x^4-(a^2+b^2+c^2)x^2=a^2b^2+a^2c^2+b^2c^2-a^4-b^4-c^4$, whence

$x^2=\frac{1}{2}[a^2+b^2+c^2+\sqrt{3}\sqrt{2a^2b^2+2a^2c^2+2b^2c^2-a^4-b^4-c^4}]$ or if we denote the area of the triangle whose sides are a , b , c , by Δ , we obtain the elegant expression, $x^2=\frac{1}{2}[a^2+b^2+c^2+4\Delta\sqrt{3}]$.

Substituting numerical values, we find $x^2=\frac{3}{2}[715+\sqrt{401557}]=44.97+$. The minus value of the radical must be rejected for the case that O is without the triangle.

Also solved in various ways by P. S. BERG, J. W. WATSON, H. C. WHITAKER, R. H. YOUNG, G. B. ZERR, L. B. FRAKER, and the PROPOSER.

16. Proposed by COLMAN BANCROFT, Professor of Mathematics, Hiram College, Hiram, Ohio.

A traveler whose speed constantly increases in a geometrical progression passes A at 2 o'clock, B at 3:30, C at 4:30, and D at 6:18. At B he is moving at the rate of 12 miles per hour, and at C 18 miles. Find his rate at A and D , and the distance from A to each of the points B , C , and D .

Solution by H. C. WHITAKER, B. S., M. E., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.

Let a denote the rate at A , d the rate at D , r the rate of acceleration per hour. At the end of time t after 2 o'clock, the rate will be $a\left(1+\frac{r}{x}\right)^{tx}$, x being the number of times per hour the acceleration is added; this when x is infinite equals ae^{tr} ; hence the equations $ae^{1.5r}=12$, $ae^{2.5r}=18$, $ae^{4.3r}=d$.

$$\text{The distance}=\int_0^t ae^{tr}dt=\frac{a}{r}(e^{tr}-1).$$

Substituting for e its value 2.71828 and solving these equations,

